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TABLE OF CONTENTS.

PRELIMINARY REPORT ON THE LIFE-HISTORIES OF TWO SPECIES OF SYRPHIDAE.

C. L. METCALF.

For many years it has been well known that the larvae of certain genera of Syrphidae feed upon plant lice (Aphidae) and are important agents in keeping these highly injurious insects in check. It is therefore believed that the following notes on the immature stages of two species of these flies, although incomplete, are of enough interest to warrant this preliminary report.

The work has been done under the able direction of the Professors of Entomology at the Ohio State University. It was taken up at the suggestion of Professor James S. Hine, to whom I am especially indebted for many valuable suggestions and criticisms.

DESCRIPTION.

Didea fuscipes Loew.

LARVA.

Length, 12–15 mm., width 5–6 mm., height 3–4 mm. The larvae are testaceous brown, footless, eyeless grubs. The head is not distinctly differentiated. Shape flattened, sub-cylindrical blunt at the posterior end, tapering and obtusely pointed in front when extended (Fig. 2.) The head segments are usually very much retracted when the larva is at rest giving to the anterior end a bluntly rounded appearance. The body is divided up into twelve more or less apparent segments, each, except the first two and the last, marked by several transverse folds of the integument. On the elevations of these folds in each segment are situated twelve long bristles in a transverse row. Of these the four nearest the mid-

dorsal line crown the summits of prominent conical projections which, like the rest of the dorsum, are close-set with short radiating black bristles. The second of these projections from the middle line on each side is about one-third as large as the first and situated on the succeeding fold. These transverse folds are continued laterally into distinct V-shaped prominences which with those of other segments form a zig-zag longitudinal carina along each side of the body. The third spine from the middle-line on each side is situated at the apex of this V; the fourth at the apex of a similar, underlying lateral cone or V; in front of which a small ventrally-projecting fold forms two smaller spiny prominences bearing the fifth and sixth bristles. These form the lateral borders of the larva and give to it a very irregular outline of sharp angular projections.

On the ventral part of the first segment are situated the mouth-parts and dorsal to these the antennae. The mouth-parts consist of two jaw-like pieces working longitudinally and at the sides of these three pairs of mouth-hooks adapted to work transversely (Fig. 3.) The jaws are continued internally into a tube-like oesophagus or gullet. All the parts are black and firmly chitinised. The antennae are very small consisting of a single fleshy joint with two minute rounded segments side by side at its apex. Surrounding these parts are a dozen or more small sensory papillae.

In the middle of the third segment is a pair of anterior spiracles. These are light brown, conical, with a semi-circular slit near the apex (Fig. 4).

On the anterior part of the dorsum of the last segment is situated the posterior breathing organ (Figs. 2,b;5). This consists of two closely apposed, short, cylindrical breathing-tubes, united along the middle line, slightly divergent at the tip. They are hard, black, firmly chitinised structures, each with three slit-like spiracles raised on radiating carinae. Anteriorly near the middle line each is marked by a smooth circular plate; and the surface of the appendages between the spiracles bears several sharp irregular ridges. The alimentary canal opens ventrally on the last segment.

The integument of these larvae is exceedingly tough but transparent. The entire dorsal and lateral surfaces are beset with numerous, minute, short black bristles. The ventrum is bare. Along the mid-dorsal line for the greater part of its length the dorsal blood-vessel is visible through the body-wall. It is a poorly-defined, dark line with five or six lateral expansions.

This fly is only tolerably common about Columbus. I was able to find the young fairly common in the autumn of 1909; but they were rare in 1910, owing perhaps to the greater scarcity of their food the latter season. From the observations made it is probable that the larvae of the autumn generation of this fly do not appear before the last week in September or the first of Octo-

ber. The middle of September none were to be found. On October 10, 1910, four larvae of this species were collected from Sycamore. Eight days later one of them pupated. I have not determined accurately the duration in the larval stage.

The larvae of *Didea fuscipes* live in the colonies of the large aphid, *Longistigma* (*Lachnus*) *caryae* Harris which appear so abundantly in fall on the under sides of the lower horizontal branches of the Sycamore (*Platanus occidentalis* L.). I have also found the larvae on a Basswood tree (*Tilia americana* L.) affected with these plant lice. They are apparently closely restricted in food-habits to the body fluids of this one kind of aphid and may be expected wherever *Longistigma caryae* occurs with any regularity. They are rather sluggish and probably often spend their entire lifetime among the particular group of plant-lice in which they hatch.

When feeding the larva seizes an aphid with the hooks of its mouth-parts. The body-wall is punctured and the juices, which alone are eaten, are slowly sucked out leaving the body-wall shrunken and crumpled. These dried-up skins can frequently be found on the branches where larvae have fed. It is my belief that these flies destroy large enough numbers of the aphids to be of considerable economic importance in keeping them in check.

The excrement of the larva is dark purplish in color and leaves conspicuous blotches on the white sycamore bark. The moist excrement seems to be of use in helping the larva to cling to the surface of the bark.

I have discovered no habits of protection in the larval stage more than that derived from the surrounding colony of aphids. They are certainly not conspicuous when so located. The location on the under side of the twigs is no doubt a protection from the weather and from some birds; but this is, I think, entirely incidental to the similar location of their prey. The covering of spines and especially the conspicuous bristly prominences may be defensive.

I have found no particular enemies of this stage.

PUPA.

The pupa is concealed in the hardened, slightly inflated, sub-cylindrical, last larval skin, within which the changes to the adult form take place. As the larva approaches metamorphosis it attaches itself usually to a somewhat protected place on the under surface of the limb. The anterior segments are retracted, the skin becomes inflated filling out the wrinkles characteristic of the larva. It rounds out anteriorly and dorsally, the point midway between the fourth and fifth segments coming to lie at the anterior pole, the mouth being shunted backward on the ventral side

Length 9.5–10 mm., width 4.5–5 mm., height about 4.5 mm. Color, Roman sepia, a little darker than the larva. The puparium is broadest a little back of the sixth larval segment, is nicely rounded in front, and tapers gradually to the last segment which remains somewhat flattened, especially at the sides. The covering of small black bristles is retained and the black conical prominences become even more conspicuous owing to the inflation (Figs. 6, 7). The posterior breathing appendages are retained.

The date of pupation was about the middle of October. Indoors the duration in the pupal stage was about 20 days.

I have made no observations which would indicate that the larvae crawl far before changing to the pupae. I have found pupae on the under sides of the horizontal branches of the Sycamore not far from the colonies of plant lice among which they fed.

The shining brown color together with the black, spiny, conical projections on the dorsal side give to the pupa of *Didea fuscipes* a characteristic appearance easily distinguished from that of the other Syrphidae I have seen. The pupae are protected by the indurated puparium and somewhat by the sheltered position on the bark taken up by the larvae.

I have found the pupa late in November and it is probable that the fly passes the winter in this stage.

The adults have been taken from the middle of May to the last of September. I have studied only the autumn generation of larvae.

The adults emerge by bursting off a circular lid of the pupa case (Fig. 7). This is accomplished by expansion of the lower part of the face

ADULT.

♀, ♂. Length 11–15 mm.

Description, slightly modified from Williston. Bull. U. S. Nat. Mus., No. 31, 89 (1886). Face yellow, with a small elongate brownish spot on the tubercle. Front yellow, with two brownish spots above the antennae, or, in the female, with an inverted V-shaped brown stripe connected with the black of the upper part of the front. Eyes bare. Orbits thickly yellowish pollinose, posteriorly with a fringe of yellowish-whitish pile. Antennae black, the third joint at the base sometimes reddish, elongate oval, obtusely pointed at the tip; arista reddish. Thorax shining greenish black, on the meso-, ptero-, and sterno-pleurae yellow, thickly covered with similar colored pollen and pile. Scuttelum light yellow, translucent. Wings grayish hyaline, the base before the humeral cross-vein and the stigma brown; the remainder of the sub-costal cell and the costal cell may be brownish; third vein rather deeply curved near the middle of the first posterior cell. Legs brown, the posterior tibiae and all the tarsi blackish; sometimes the legs are luteous, the base of

femora, distal portion of tibiae, and the tarsi brown. Abdomen black, with four yellow cross bands, the first consisting of two large ovate spots, narrowly separated and reaching the lateral margins in nearly their full width; second and third cross-bands broad separated from the lateral margins by a black narrow keeled border; they are much narrower in the middle of the segments, the front margin straight, touching the anterior edge of the segments; fourth band similar, but much smaller and attaining the margin; all the black is velvety opaque except the narrow posterior margin of the segments which is shining, dilated in the middle.

Syrphus torvus Osten Sacken.

LARVA.

Length, 10–12 mm., width 3–4 mm., height about 2 mm. Shape sub-cylindrical, tapering rapidly in front to the mouth parts, slightly narrowed but blunt and emarginate at posterior end.

The body consists of twelve more or less apparent segments each except the first two and the last crossed by a transverse row of twelve light-colored spines. Ten of these are in line, the most ventral on each side being situated in front of the others. The integument is raised into numerous transverse folds continued laterally into a distinct longitudinal keel on each side (Fig. 10). First three body segments small, retractile, gradually thicker; next eight sub-equal; terminal segment flattened, bearing on its dorsal surface the caudal spiracles. These as in *Didea* are borne upon two short cylindrical approximate appendages and are placed within clefts at the summit of three radially arranged carinae on each appendage (Fig. 13). These carinae are narrower and longer than those in Didea. The rounded plate-like piece is present on the anterior part but the surface shows only a few blunt projections. On the ventral part of this segment is the opening of the alimentary canal. The mouth-parts are terminal and are similar to those of *Didea* except for an additional pair of black chitinous recurved hooklets at the sides (Fig. 11). Surrounding them on the first two segments are a number of small sense papillae (Fig. 11, *h*). The first segment also bears the antennae (Fig. 11, *f*). These are very small, similar to preceding species. Between the second and third segments dorsally is a pair of small brownish anterior spiracles (Figs. 10*a*, 11*g*); conical, the semicircular slit guarded by seven rounded teeth (Fig. 12).

The general color of the larvae is brown pink. The integument is tough but transparent; naked but very finely papillose. The black mid-dorsal blood vessel is more prominent than in *Didea* and in the living active larvae the blood may be seen pulsating regularly from posterior to anterior end. Laterad to this blood vessel are two long yellowish bundles of fat irregularly

outlined extending practically the full length and varying in width. At the approach to metamorphosis these adipose masses increase in extent sometimes covering nearly the entire dorsum except the blood-vessel. At times also the body fluid invades more or less the fatty bodies appearing as outlying pulsating pockets.

This fly is abundant in this region and has been taken from April 1 to September 10. The stages have not been followed throughout the year and the egg has not been studied.

The autumn generation of larvae appears on cabbage affected by plant lice usually during the latter half of September, becoming abundant from the first to the middle of October. During the fall of 1909 the study was not taken up until about the middle of October. At this time larvae were plentiful and were found at the University farm until the first of November when the host plants were removed. When the writer returned to Columbus the middle of September, 1910, very few aphids or larvae of Syrphidae were to be found and none of *Syrphus torvus*. The latter appeared after those of other species, not becoming abundant until the first week in October. They were still fairly plentiful the middle of October.

I have not determined the duration in the larval stage. Some larvae taken Octover 15 and kept on sparse diet remained unchanged December 3, showing their great tenacity of life.

The larvae live on cabbage and related plants crawling about on the surface of the outer leaves and as far inward as is accessible without boring. The food of the larvae is usually the body juices of the cabbage plant-louse (*Aphis brassicae* Linn). I have found some of this species on Sycamore feeding on *Longistigma caryae* but they are much more abundant on cabbage. Confined larvae readily change to the latter kind of food in absence of the cabbage aphids. The larvae are sometimes found on plants on which there are no aphids; but usually there is an abundance of prey at hand.

The louse is seized by the hooks and jaws of the mouth of the larva and held in the air while the juices of its body are sucked out. I have found no particular enemies of this stage. They are often well protected from birds among the inner leaves.

PUPA.

In changing to the pupa the larval skin contracts to form a puparium. The body becomes shorter, more oval, expanded dorsally in front and of a darker color. Length 8–8.25 mm., width 3.5–4.3 mm., height 3.75–4 mm. Testaceous brown, naked, smooth except for slight remains of the transverse wrinkling of larva. (Fig. 14). Broadest in front of the middle, nicely rounded in front, descending rapidly at the posterior end to the projecting caudal spircales (Fig. 15).

ADULT.

Length, ♂ ♀ 10–12.5 mm.

Description, slightly modified after Osten Sacken. Proc. Bost. Soc. N. H., XVIII, 139 (1875).

Female (Fig. 9): Face and cheeks yellow with a very slight bluish reflection, covered with fine scattered yellow and black pile; a faint grayish spot on the cheeks under the eyes; oral margin in front narrowly brownish. Front and vertex shining black with black pile; the front on both sides along the eyes with a broad border of yellowish pollen sometimes meeting the similar border of the opposite side. This pollen continues in dilute form down the sides of the face crossing narrowly beneath the antennae. Eyes pubescent (in many specimens the pubescence is very much rubbed off and very difficult to perceive) posterior orbits covered with white pile and pollen. Antennae inserted beneath a double arched ledge of front. The dark color of the front begins immediately above their root forming a blackish brown arch with a projecting angle in the middle. Antennae dark brown; third antennal joint below and the bare arista sometimes more or less reddish. Face in profile perpendicular beneath the antennae produced but little below the eyes, slightly concave beneath the antennae to oblique tubercle, receding below (Fig. 16). Thorax dull greenish with but little lustre; in well preserved specimens with three faint dorsal longitudinal darker stripes, divergent posteriorly; scutellum dull yellowish with a slight bluish reflection. The black pile of scutellum and dorsum of thorax changes to yellow on the sides of the latter where it is also much thicker and longer. Wings large considerably longer than abdomen. Third longitudinal vein nearly straight; anterior cross-vein a third of the way from base to apex of the discal cell; anterior outer angle of first posterior cell acute. Entire subcostal cell brown; root of wings as far as humeral cross-vein and the costal cell slightly tinged with brown. Legs slender; coxae and basal third of femora black; on the hind pair the black reaches beyond the middle of the femora; hind tibiae often with a brownish ring; four anterior tarsi brown the root of the first joint often reddish; hind tarsi dark brown.

Abdomen oval slightly broader than thorax; about twice as long; with three prominent yellow cross bands, the first interrupted in the middle, all attaining the lateral margins. First segment entirely black; second segment with a yellow elliptical spot about the middle on each side prolonged usually as a narrow neck which reaches forward and touches the margin. Third and fourth segments each with a yellow cross-band on its anterior half, the hind margins of these bands very gently biconvex with a very shallow sinus at the middle; on each side the cross bands are

attenuated and curved forward so as to reach the anterior margin of the segment. The band on the fourth segment also touches its anterior margin in the middle, while that on the third is more remote from the anterior margin; the black interval between the bands is twice as broad as the bands. The fourth and fifth segments have yellow posterior margins, the fifth usually with two yellow spots on each side at the anterior margin.

Male. "Similar to the female but abdominal cross bands broader, the biconvexity on their hind side stronger, and the sinus in the middle deeper; the gray spot on the cheeks under the eye often larger, sometimes occupying a considerable portion of the cheek; the brown ring on the hind tibiae usually expanded so as to reach the tip of the tibiae. The eyes (contiguous) are more distinctly pubescent, the front is beset with yellow pollen except a narrow black space above the antennae."

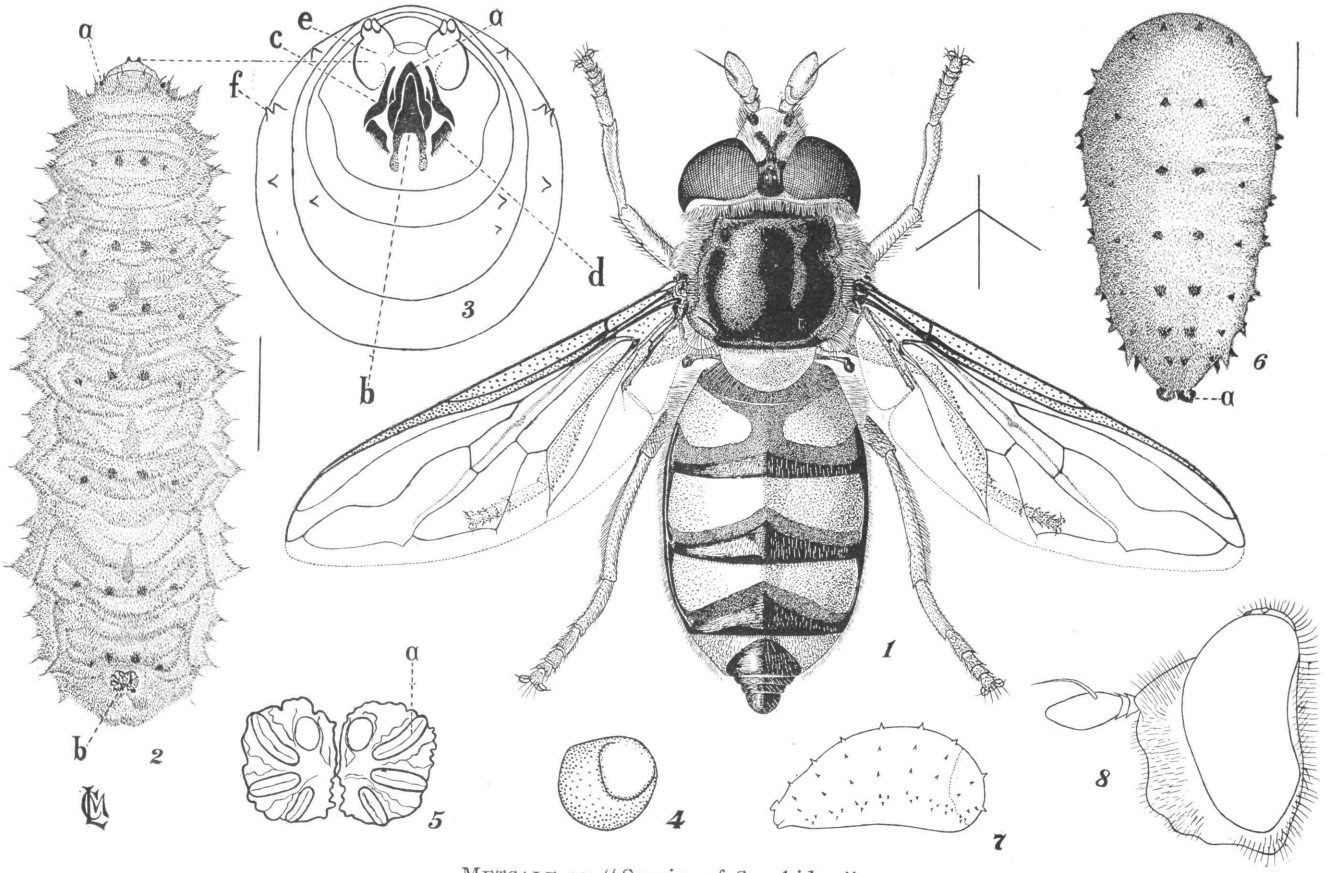
Explanation of Plates XVI and XVII.

Figures 1–8, *Didea fuscipes* Loew.

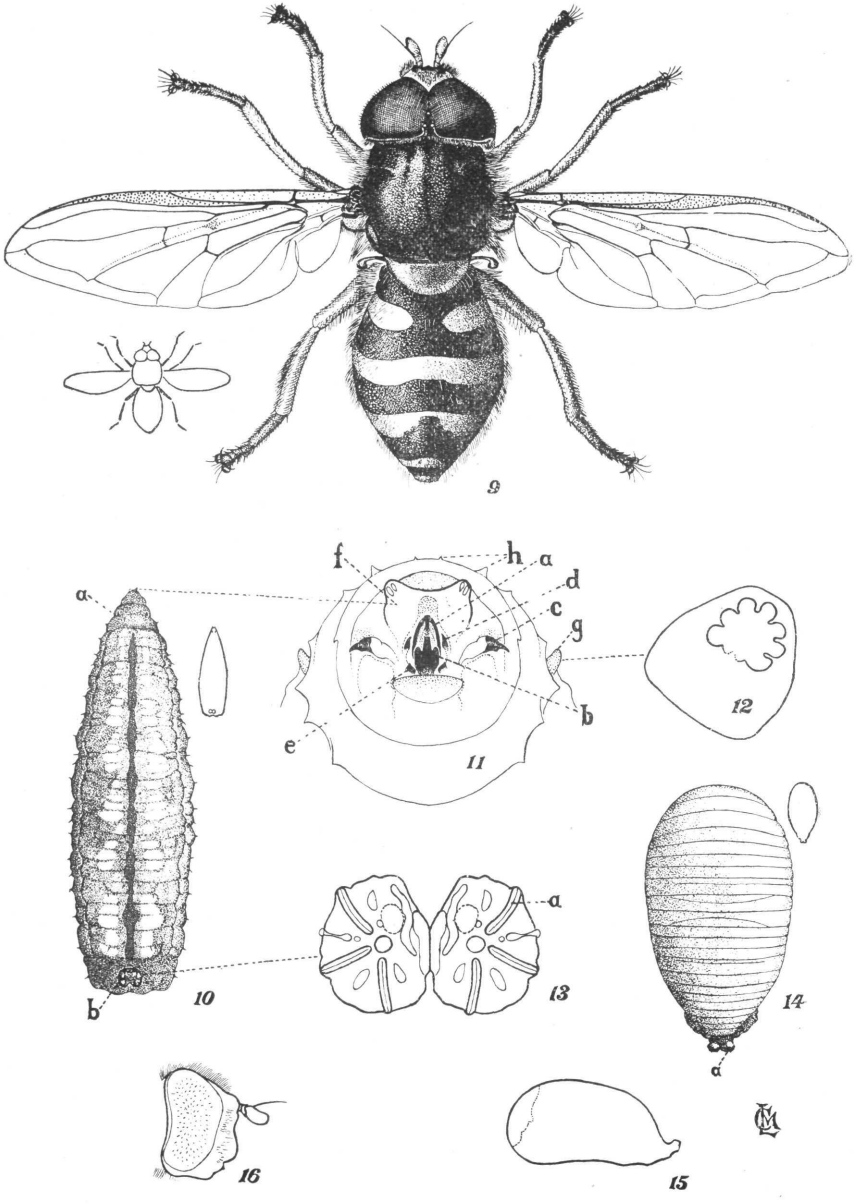
Fig. 1. Adult female x6.
Fig. 2. Larva about six times natural size; *a*, anterior spiracle; *b*, caudal spiracles.
Fig. 3. Antero-ventral view of head and mouth-parts of larva, enlarged; *a*, upper jaw with a small pair of hooklets at the side; *b*, lower jaw; *c* and *d*, lateral hooklets; *e*, antenna; *f*, sense papillae.
Fig. 4. Right anterior spiracle much magnified.
Fig. 5. Posterior breathing organs enlarged; *a*, one of the radiating spiracles.
Fig. 6. Dorsal view of puparium a little more than five times natural size; *a*, caudal spiracles.
Fig. 7. Puparium from the side showing arrangement of spines and line of cleavage for escape of adult.
Fig. 8. Head of male in profile.

Figures 9–16 *Syrphus torvus* Loew.

Fig. 9. Adult male natural size and enlarged.
Fig. 10. Larva natural size and enlarged; *a*, anterior spiracle; *b*, posterior spiracles.
Fig. 11. Antero-ventral view of head and mouth-parts much enlarged; *a* and *b*, upper and lower jaw partially separated; *c*, outer pair of mouth-hooks; *d* and *e*, two inner pairs of mouth-hooklets; *f*, antenna; *g*, anterior spiracle; *h*, sense papillae.
Fig. 12. Anterior spiracle of larva highly magnified.
Fig. 13. Posterior breathing appendages much enlarged; *a*, one of the six caudal spiracles.
Fig. 14. Puparium from above natural size and enlarged; *a*, posterior spiracles.
Fig. 15. Puparium from side showing line of cleavage for escape of adult.
Fig. 16. Head of female in profile.



METCALF on "Species of Syrphidae."



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